PhD position

Reducing MR field strength domain shift: Deep Learning Models for Reconstruction and Segmentation of Fetal and Newborn Brain low-field MRI

Location:
Lausanne University Hospital (CHUV)
Centre de recherche en Radiologie
Rue Pépinet 2, 2ème étage
CH-1003 Lausanne, Switzerland

Starting/Duration:
As of Septembre 2023, 4 years, annual renewal

Background

Today, machine learning methods applied to brain MRI at 1.5T or 3T enable the **extraction of imaging biomarkers of the early brain maturation** and their association to later cognitive-psychological conditions and behavioral changes. Assessing the impact of brain development in fetal, preterm, and newborn populations later in life is however limited by the **domain shift between pre- and postnatal imaging techniques**. Furthermore, at the global level, existing neurodevelopmental studies are also skewed by excluding a wide part of the population due to limited access to MRI, thus narrowing our understanding of brain development in normal conditions as well as in situations of malnutrition, infection, or stress, which are predominant in middle- and low-income countries. The recent push for low-field MRI could be the game changer towards the democratization of pediatric neuroimaging. Low-field MR scanners allow a more cost effective and more widely accessible MRI technology, particularly in developing countries with large pediatric populations. However, there is an **important distributional shift arising from low magnetic field strength**, due to the associated reduction in signal-to-noise ratio and image spatial resolution.

Project description

This PhD thesis is funded by the Swiss National Research Foundation in Switzerland which supported the research project **"Tackling domain shifts in pediatric neuroimaging: bridging advanced computational MR techniques and clinical practice"** (205320-215641). The project tackles these two important domain shifts in pediatric MRI, linked to the magnetic field strengths and to population gaps. The PhD candidate will **develop deep learning approaches,** primarily in the areas of **generative modeling and representation learning to overcome domain-shift robust** methods for **motion estimation, super-resolution reconstruction and segmentation** of fetal and newborn brain MRI**.** The developed methods will be applied at low-field (0.55T) and high field (1.5T and 3T) MRI acquisitions.

Collaborators

- **Lausanne University Hospital** (CHUV) : Vincent Dunet, Patric Hagmann, Mériam Koob, Juliane Schneider, Anita Truttmann
- **Siemens Healthineers**: Tobias Kober
- **King's College London**: Maria Deprez, Jana Hutter
- **CIBM MRI CHUV-UNIL**: Matthias Stuber
- **CIBM SP EPFL**: Pol Del Aguila Pla, Michael Unser.

Your profile

- A master's (MSc) degree in physics, computer science, or electrical engineering, or similar degree with an equivalent academic level.
- A genuine interest in signal and image processing and machine learning techniques is a must.
- A strong will to develop clinically actionable methods and to interact with clinicians is required.
- Strong analytical and mathematical backgrounds.
- Good programming skills Python, Matlab and C++, including full stack and deep learning frameworks (PyTorch or TensorFlow).
- Prior exposure to medical imaging and or neuroimaging is a plus.
- Good skills in English (oral and written) are required. Knowledge in French is a plus.
- Rigorous work habits, a curious and critical mind, and a good sense of initiative.
- A high-level perseverance and a strong personal commitment are expected.

We offer

- A multidisciplinary project between cutting-edge brain imaging and advanced image processing, machine learning, and clinical applications.
- A dynamic, interdisciplinary, and international team of very motivated people.
- A stimulating working environment.
- Access to cutting-edge technology and state-of-the-art resources.

How to apply

Please send your CV, two references and a motivation letter to Dr. Meritxell Cuadra (meritxell.bachcuadra@unil.ch).

IMPORTANT: Successful applications are **subject to academic approval from the University of Lausanne and the Doctoral School**; the selected candidate will be enrolled in the Life Science Doctoral School at the Faculty of Biology and Medicine of the Lausanne University.

About CIBM

The CIBM Center for Biomedical Imaging was founded in 2004 and is the result of a major research and teaching initiative of the partners in the Science-Vie-Société (SVS) project between the Ecole Polytechnique Fédérale de Lausanne (EPFL), the Université de Lausanne (UNIL), Université de Genève (UNIGE), the Hôpitaux Universitaires de Genève (HUG) and the Centre Hospitalier Universitaire Vaudois (CHUV), with the generous support from the Fondation Leenaards and Fondation Louis-Jeantet.

CIBM brings together highly qualified, diverse, complementary and multidisciplinary groups of people with common interest in biomedical imaging.

We welcome you in joining the CIBM Community.

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